ORIGINAL

Before the
FEDERAL COMMUNICATIONS COMMISSION DOCKET FILE COPY ORIGINAL
Washington, D.C. 20554

RECEIVED
SEP 15 1997
FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of	)	
	)	
Reallocation of Television	)	ET Docket No. 97-157
Channels 60-69,	)	
The 476-806 MHz Band	)	

COMMENTS OF AERONAUTICAL RADIO, INC.

Aeronautical Radio, Inc. ("ARINC"), by its attorneys, hereby submits its Comments in Response to the Commission's Notice of Proposed Rulemaking released July 10, 1997 (62 Fed. Reg. 41012).

ARINC is the communications company of the air transport industry, and has provided that industry with communications and navigation support for almost seven decades. ARINC and its industry committees[1] have been active in developing and implementing specifications and technology for the utilization of the worldwide global navigation and surveillance system (GNSS) sponsored by the International Civil Aviation Organization (ICAO). ARINC has also participated in efforts of RTCA to delineate the conditions necessary to ensure that the international GNSS can safely and efficiently guide aircraft from the initiation to termination of flight.

[1] Four industry committees are sponsored by ARINC: the Aeronautical Frequency Committee (AFC), the Airlines Electronic Engineering Committee (AEEC), the Aviation Maintenance Conference (AMC), and the Flight Simulator Engineering and Maintenance Conference (FSEMC).

The FCC has proposed to revise the allocations for television channels 60 through 69 to meet important land mobile communications requirements, but has not yet addressed the technical standards for operation of these new land mobile systems. ARINC and the air transport industry are concerned with such a reallocation because it may increase the possibility of interference to the two systems comprising GNSS—the United States' Global Positioning System (GPS) and the Russian Global Navigation and Surveillance System (GLONASS). The second harmonic of radio transmissions in the band 779.5-805 MHz (all or part of channels 65 through 69) fall within the GNSS band 1559-1610 MHz. The band 1559-1610 MHz is allocated domestically and internationally to the aeronautical radionavigation service, a safety service that must be protected by the United States from harmful interference.[2]

The international GNSS, and especially the United States GPS, will be the primary means of air navigation in the future. The Federal Aviation Administration (FAA) has stopped deploying new microwave landing systems (MLS) because GNSS offers better navigation information for all phases of flight, including instrument landing of aircraft. The FCC should be careful to protect this system that has already become critical to the safety of flight. The revisions to the allocations for television channels 60 through 69 should take into account the need to protect GNSS from harmful interference.

More specifically, the allocation of channels 65 through 69 to the mobile services could increase the possibility that second harmonic interference will occur to aircraft operating with GNSS, both during the enroute portion of flight and in the terminal areas. While the analog television broadcast stations currently using the band are much higher in power than would be

---

[2] *See* ITU Radio Regulation 953.

the mobile systems, they are located at a few fixed locations and tests have shown that the television transmitters typically suppress out of band emissions substantially more than required by the FCC.[3] These two factors significantly reduce the potential for interference to GNSS under the present allocation.

Mobile operations in this band will place base stations at more locations than the limited number of television stations, and the mobile units will be operating throughout the area served by aviation. Indeed, the mobile units could be operating as close as 100 feet of aircraft landing at the nation's airports, an area where the need for precision operation of the GNSS receivers is especially critical. Current rules in Part 90 concerning the emission masks and permissible transmitter power would indicate that the spurious emissions in the band 1559-1610 could be in the range of -42 to -50 dBW for the mobiles and -35 to -43 dBW for the base stations, depending upon the actual power of the unit and the emission mask to be utilized for systems operating in the band 779.5-805 MHz.[4] Spurious emissions at these levels in the band 1559-1610 MHz would interfere with GNSS at critical times of flight and seriously impair flight safety.

Attached is a typical calculation of possible enroute interference from a base station or a television station at a fixed location due to wideband noise. The distance used in the calculation is 500 feet because that is the minimum separation permitted between an enroute aircraft and any

[3] Suppression of out-of-band emissions by analog television stations to a level of 100 dB is done to improve the video performance. It is not clear that the same incentives will apply to digital television, and the FCC may have to legislate greater out-of-band suppression than currently required by the broadcast rules.

[4] *See* 47 C.F.R. § 90.210.

obstacle in what the FAA defines as an "uncongested" area.[5] Different separation distances could be used in specific situations. This calculation is based on ITU-R Draft Recommendation M.[8D/XZ] (Revision 1 to Document 8/114) that requires TDMA emissions in the band 1559-1605 MHz to be limited to -70 dBW/MHz.

The second harmonic from a mobile transmitter would require greater suppression because aircraft can be within 100 feet of the land mobile transmitter when landing or taking off and the signal is likely to be narrowband. The mobile units using the accepted protection requirements contained in Draft Recommendation M.[80/XZ] from narrowband noise should be limited to an out-of-band ERP of -80 dBW in the band 1559-1605 MHz.

---

[5] 14 C.F.R. § 91.119(c). In congested areas, the required separation is 1000 feet. 14 C.F.R. § 91.119(d).

ARINC and the air transport industry do not object to the reallocation of spectrum for critical land mobile communications requirements. It would be prudent at this time early in the planning to develop standards which will provide sufficient out-of-band suppression for the second harmonic to protect operation of GNSS in the band 1559-1610 MHz.

Respectfully Submitted,

AERONAUTICAL RADIO, INC.

By: _____

John L. Bartlett
of
WILEY, REIN & FIELDING
1776 K Street, N.W.
Washington, DC 20006-2304
(202) 429-7070
Its Attorneys

September 15, 1997

Technical Appendix

NPRM Reallocation of the 746-806 MHz Band
ET Docket 97-157

1. The FCC proposes to change the spectrum allocation of television channels 60-69 in the 746-806 MHz band. Television channel 66 currently operates in this band and its 2nd harmonic falls in the 1559-1610 MHz band used by the ICAO Global Navigation Satellite System (GNSS) which includes the satellite systems of Global Positioning System (GPS), GLONASS and spaced based and ground based augmentations of the US Wide Area Augmentation System (WAAS) and Local Area Augmentation System (LAAS) including pseudolites at or near the GPS frequency.

2. RTCA/DO-235, *Assessment of Radio Frequency Interference Relevant to the GNSS*, discusses interference from television in section 7.3. The current requirement of 60 dB below the carrier for the second harmonic of channel 66 could have caused an interference to GPS operations out to at least 100 miles. However, it was found that the actual harmonic level had been attenuated more than 100 dB to ensure a quality picture. With digital TV increased attenuation is not needed to ensure a quality picture. A 60 dB attenuation requirement for digital TV would mean serious interference problems for GNSS operations. Increased attenuation is required for digital TV.

3. For mobile satellite Earth stations, RTCA/DO-235 recommends a -70 dBW/MHz in the 1559-1580.5 MHz band because the mobile can be as close as 100 ft from an aircraft. This value has also been accepted by the International Telecommunication Union (ITU) in Draft New Recommendation ITU-R M. [8D/XZ] (Revision 1 to Document 8/114), Essential Technical Requirements of Mobile-Satellite Service Systems in the Bands 1 - 3 GHz for TDMA systems in the 1559-1605 MHz band and for CDMA systems in the 1559-1580.5 MHz band. Any reallocation of the 746-806 MHz band to mobile service should have this same limit applied to the mobile equipment to ensure that GNSS operations are free from harmful interference.

4. Fixed service and TV have similar interference situations in that they are both at a fixed location and that location should be more than 100 feet from any aircraft. The attenuation of 2nd harmonic levels can be estimated by application of the interference model in Draft New Recommendation ITU-R M.[8D/XO] (Document 8/59). Attachment 1 provides an example of this evaluation for an aircraft 500 feet from the interfering source. To determine the amount of attenuation needed to ensure interference free operation, subtract the value in i) from the transmitter power in dBm.

5. The above analysis shows that an allocation to a mobile service requires an emission limit of -70 dBW/MHz in the 1559-1605 MHz band. A higher value may be allowed for a fixed or TV station depending on the potential distance between the aircraft and the interfering station. This requirement to protect GNSS should be included in any reallocation of TV spectrum.

Attachment 1 - Example GNSS interference calculation for a fixed or TV station

Model for the Development of Radionavigation-Satellite Interference Levels

	Desired Signal	Interference Signal	Comments
a) Minimum Satellite Signal Level Specified at Receiving Antenna's Surface (dBm)	-130 dBm		Depends on RNSS design. For GPS.
b) Interference-to-Carrier Specified for receiver per bandwidth (dB/MHz or kHz)	24 dB/MHz		Receiver rated minimum value of interference-to-carrier allowed and still meet performance requirements.
c) Maximum Allowable Interference at receiver (dBm/MHz)		-106 dBm/MHz	Maximum allowed interference level based on specified RF signal level at or near the Earth's surface and receiver interference-to-carrier specification.
d) Antenna Gain Difference (dB)		2.5 dB	The difference in antenna gain towards the desired satellite signal and the interference signal.
e) Allowable Interference Signal at Antenna's Surface (dBm/MHz)		-108.5 dBm/MHz	Maximum interference density allowed at the antenna's surface.
f) Nominal Path Loss Between Antenna and Interference Source (dB)		80.4 dB	Propagation loss between receiver antenna and interference source. 20*Log(frequency MHz) + 20*Log(D)-27.56 (D=distance in meters). For 500 ft.
g) Extra Margin of Protection (dB)		5.6 dB	Extra margin to ensure protection against factors like multipath. From RTCA/DO-235.
h) Multiple Interference Source Factor (dB)		0.0 dB	If there is a potential for more than one source of interference at about the same time, an allowance should be made for the aggregate interference.
i) Maximum Emission in the RNSS bandwidth at the Distance Specified (dBm/MHz)		-33.7 dBm/MHz	If this power density is exceeded at the specified distance, further analysis is required.

Notes:

1. Assumes distance of 500 feet from fixed or TV station antenna to GNSS antenna. The distance 500 feet was taken as a possible worst case. The actual distance should be determined by how close an aircraft could be permitted to fly near the interfering antenna.

2. Antenna gain assumes that an aircraft is receiving a satellite at an elevation angle of 5 degrees with a minimum gain of -4.5 dBic and with a maximum gain of -2 dBic at zero elevation angle as per RTCA/DO-228 which results in 2.5 dB difference. This assumption could be adjusted depending on the specific location of the interfering antenna and the possible aircraft antenna relationship to the interfering antenna.

3. The interference-to-carrier of 24 dB assumes wide band interference. If the interference bandwidth is narrower, then a smaller value should be used.